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Report of the PRC / DFO 4VWX herring and mackerel tagging program

by

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Abstract

A joint tagging program started in 1998 by the Department of Fisheries and Oceans and the Pelagics Research Council, continued in 1999 and at the beginning of 2000. A total of 57 605 tags have been applied to herring on four spawning grounds, two overwintering aggregations, one summer mixing area and one experimental area. Four hundred and sixty of these tags have been recovered. A total of 13 878 mackerel tags have been applied to date with 82 recoveries.

Although there have been too few tag returns in any one area to make any firm conclusions, there have been adequate recoveries to confirm that there is an affinity between herring in the Chebucto Head overwintering area and the Southwest Nova / Bay of Fundy spawning component. The extent of this affinity is unknown.

Tagging recommendations for the next season include applying more tags to fish from each area, tagging fish from two new areas (offshore Scotian Shelf and Bras d'Or Lakes) and renewing the advertising campaign. It is also recommended that investigations into the turnover rates on the spawning grounds, tag shedding and tagging mortality be included to enhance this tagging study.

Résumé

Un programme de marquage a été mis en oeuvre conjointement en 1998 par le ministère des Pêches et des Océans et le Conseil de recherche sur les poissons pélagiques et s'est poursuivi en 1999 et au début de l'an 2000. Un total de 57 605 étiquettes ont été placées sur des harengs de quatre aires de frai, dont deux zones de concentration d'hivernage, une zone de mélange d'été et une zone expérimentale. Des étiquettes placées, quatre cent soixante ont été récupérées. Un total de 13 878 étiquettes ont été placées sur des maquereaux et on a récupéré 82 étiquettes jusqu'à présent.

Alors que le nombre d'étiquettes récupérées dans une des zones est trop faible pour tirer des conclusions fermes, il y a eu suffisamment de recaptures pour confirmer qu'il existe une affinité entre le hareng de la zone d'hivernage de Chebucto Head et la composante de géniteurs de la baie de Fundy / Southwest Nova. L'importance de cette affinité est inconnue.

Les recommandations suivantes ont été formulées quant au marquage de la prochaine saison : augmenter le nombre d'étiquettes pour le poisson de chaque zone, marquer des poissons des deux nouvelles zones (zone hauturière du plateau néo-écossais et les lacs du Bras d'Or) et renouveler la campagne de publicité. Afin d'améliorer cette expérience de marquage, il est également recommandé d'effectuer des recherches sur les taux de renouvellement dans les frayères, la perte d'étiquettes et la mortalité due au marquage.

Introduction and Methods

The Pelagics Research Council (PRC) and Department of Fisheries and Oceans (DFO) began a large scale herring tagging project during the 1998 herring fishery. It was the first project of such a scale since the 1970's. The objective of this tagging program was to provide essential and necessary information on stock origin, identification, and intermixing - knowledge which is important in preserving the integrity of spawning components, in evaluating stock status and in improving management (Paul, 1999). There was one mackerel tagging excursion but unfortunately the mackerel tagging project that was initiated by the same groups was almost eliminated this year due to reduced funding.

In the first year of the project (1998), 26 230 tags were applied to herring on 3 spawning grounds (Scots Bay, Trinity Ledge, and German Bank) and to one overwintering aggregation (Chebucto Head). In 1999, 19 tagging events saw a total of 31 375 tags applied to herring on two of the spawning grounds targeted in the previous year (Scots Bay and German Bank), and on one additional spawning ground (Eastern Passage), to the summer mixing aggregation in the New Brunswick weirs and to two overwintering areas, Chedabucto Bay and Chebucto Head (Figure 1). The PRC also participated in a preliminary USA tagging trip aimed at initiating a joint tagging project in the future. Overall, a total of 57 605 tags have been applied to herring in the past two years, following the protocol described in Paul, (1999) (Appendix I and II). One successful mackerel tagging trip saw 3 019 tags applied to fish in St. Margaret's Bay (Appendix IV).

Tag recoveries have been low, but some trends can be observed in the overwintering aggregation in Chebucto Head and in the NB weir summer mixtures. Tag returns need to improve in order to make more firm conclusions on migration patterns and the stock structure of herring.

Returns following the initial year of tagging in 1998 and the returns from tagging events that occurred in the 1999 season up to Jan 9, 2000 are summarized (Table 1 and 2). The target for application has been high in the hopes of getting 100 – 200 tags back from each area since return rates are expected not to exceed 1–2%. Details of the tag applications and returns for each area are described below.

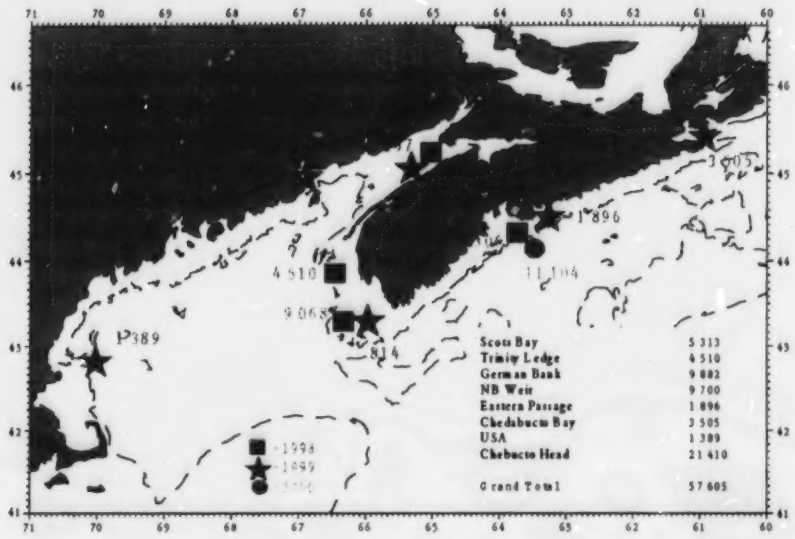

Figure 1. Tag application Sites for 1998-2000.

Table 1. Total number of herring tags returned by year and area.

Area Tagged	tags returned from 1998	tags returned from 1999	tags returned from 2000	Total
Scots Bay	25	7	0	32
German Bank	49	1	0	50
Trinity Ledge	7	0	0	7
NB Weir	0	186	0	186
Chedabucto Bay	0	14	2	16
Chebucto Head	0	105	61	166
USA	0	3	0	3
Total	81	316	63	460

Table 2. Herring tags returned after the first two weeks of release by year and area.

Area Tagged	tags returned from 1998	tags returned from 1999	tags returned from 2000	Total
Scots Bay	3	6	0	9
German Bank	25	0	0	25
Trinity Ledge	5	0	0	5
NB Weir	0	93	0	93
Chedabucto Bay	0	3	0	3
Chebucto Head	0	105	0	105
USA	0	0	0	0
Total	33	207	0	240

Spawning Grounds

Tags were placed on 'ripe and running' spawning fish from 4 spawning grounds (Figure 2) to insure that the fish belonged to the specific spawning component, and were not part of a migratory school.

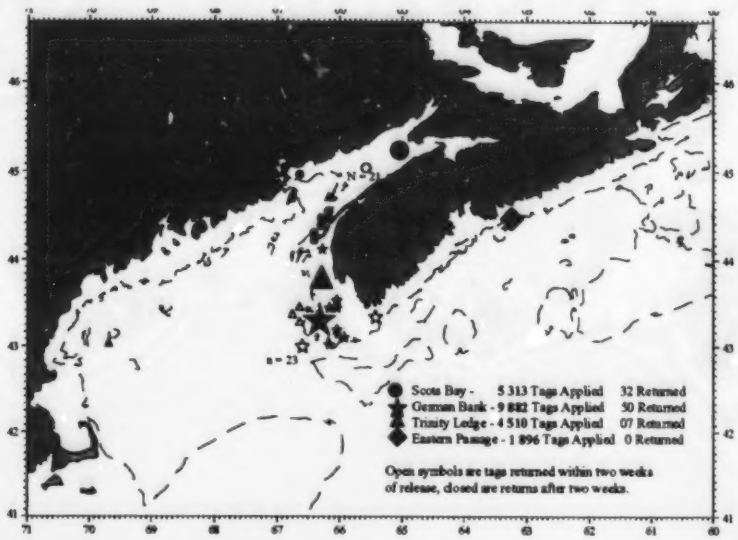
Scots Bay - 5 313 Tags Applied 32 Returned
German Bank - 9 882 Tags Applied 50 Returned
Trinity Ledge - 4 510 Tags Applied 07 Returned
Eastern Passage - 1 896 Tags Applied 0 Returned
Open symbols are tags returned within two weeks of release, closed are returns after two weeks.

Figure 2. Spawning ground tag application sites and recoveries.

Scots Bay - 2 967 tags were placed on spawning 'ripe and running' fish in Scots Bay in the 1999 fishing season. A total of 5 313 (2 346 in the 1998 season) tags have now been

applied in this area (Table 3). Tags were applied to herring on three different occasions in 1999 (August 11,12 and 21).

From the 1998 tagging effort, 25 tags have been returned (1.1%), and 7 tags have been returned from tags applied in 1999 (Table 3). The tags have been returned from Long Island Shore and the New Brunswick weir fishery (Table 4).

Table 3. Summary of tag application and recoveries for Scots Bay.

Scots Bay	# Tags Applied	# Tags Returned	# tags Returned within first 2 weeks of tagging event	% return rate (NOT adjusted to catch landings)
1998	2 346	25	22	**1.1**
1999	2 967	7	1	0.24
Total	**5 313**	**32**	23	0.60

Table 4. Summary of tag returns for Scots Bay not including tags returned within the first two weeks of release.

Tagging Date and Location	Date Returned	Location Returned
Scots Bay Aug 1998	Sept 1998	Long Island Shore (1)
	June 1999	Long Island Shore (1)
	July 1999	Unknown Location (1)
Scots Bay Aug 1999	Aug 1999	Long Island Shore (1) NB Weir (1)
	Sept 1999	Long Island Shore (1) NB Weir (1)
	Oct 1999	Long Island Shore (1) Unknown Location (1)
Scots Bay ***Combined***	Aug	Long Island Shore (1) NB Weir (1)
	Sept	Long Island Shore (2) NB Weir (1)
	Oct	Long Island Shore (1) Unknown Location (1)
	June	Long Island Shore(1)
	July	Unknown Location (1)

German Bank - 814 tags were placed on 'ripe and running' herring on German Bank in the 1999 fishing season, bringing the total for German Bank to 9 882. Tags were applied on two different occasions (September 21,22). Tagging was supposed to be done only on survey nights this year, which limited the amount of time that was available. Cancellations due to bad weather and the absence of fish on some designated tagging

nights led to fewer tags being applied than was originally planned. Tags were applied on two fishing nights. From the 1998 tagging initiative, 49 tags have been returned, and only 1 has been returned from the 1999 initiative. Areas of return include German Bank and St. Mary's Bay. The return rate has been 0.5% for tags applied in this area (Table 5, Table 6)

Table 5. Summary of tag application and recoveries for German Bank.

German Bank	# Tags Applied	# Tags Returned	# tags Returned within first 2 weeks of tagging event	% return rate (NOT adjusted to catch landings)
1998	9 068	49	24	**0.54**
1999	814	1	1	0.12
Total	**9 882**	**50**	25	0.50

Table 6. Summary of tag returns for German Bank not including tags returned within the first two weeks of release.

Tagging Location And Date	Date Returned	Location Returned (# returned)
German Bank Aug. & Sept. 1998	Sept 1998	German Bank (6) Location Unknown (2)
	June 1999	St. Mary's Bay (1)
German Bank Sept. 1999		
	Date Unknown	Location Unknown (16)

Trinity Ledge – There were no tags placed on the spawning ground at Trinity Ledge this year due to bad weather cancellations and a lack of fish on designated tagging nights. Although this is disappointing, provisions will be made in the next tagging season to insure that this will not happen again. Seven tags from the 1998 effort have been returned from the Long Island Shore and Platt's Bank USA (Table 7, Table 8). The tag return rate for Trinity Ledge has been 0.15% to date (Table 7).

Table 7. Summary of tag application and recoveries for Trinity Ledge.

Trinity Ledge	# Tags Applied	# Tags Returned	# tags Returned within first 2 weeks of tagging event	% return rate (NOT adjusted to catch landings)
1998	4 510	7	2	**0.15**
1999	0	0	0	0
Total	**4 510**	**7**	2	0.15

Table 8. Summary of tag returns for Trinity Ledge not including tags returned within the first two weeks of release.

Tagging Location And Date	Date Returned	Location Returned (# returned)
Trinity Ledge Aug. & Sept. 1998	Mar 1999	Platts Bank (1)
	July 1999	Long Island Shore (1)
	Oct 1999	Location Unknown (1)
	Date Unknown	Location Unknown (2)

Eastern Passage – A total of 1 896 tags were applied to 'ripe and running' fish off Eastern Passage from September 29 to Oct 1, 1999. The sailing schedule for this trip depended upon high and low tides at Three Fathom Harbour, and gale warnings. There have been no returns to date.

Summer Mixing

Aggregations of juvenile herring and of pre-spawning adults in the mouth of the Bay of Fundy are assumed to be mixtures of fish from several spawning grounds. Tagging fish from these mixing areas would help define the degree of mixing of these fish (Paul, 1999).

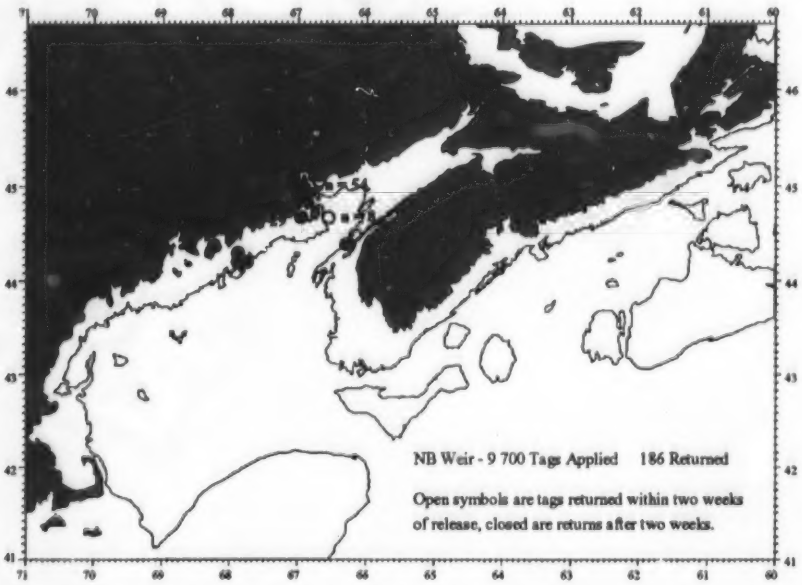
NB Weir - 9 700 Tags Applied 186 Returned
Open symbols are tags returned within two weeks of release, closed are returns after two weeks.

Figure 3. Tag application site and recoveries for New Brunswick weir summer mixing aggregation.

New Brunswick Weir - One summer mixing aggregation was targeted from the proposed areas. There were 9 700 tags applied to small summer mixing juveniles and adults in the New Brunswick weir fishery (Figure 3). With the help of many volunteers,

the tags were applied to herring in the weirs on eight different occasions during August and September. One hundred eighty six tags have been returned from areas such as NB Weirs, Long Island Shore, Schoodic Ridge, and from seiners around Grand Manan and the Wolves. There has been a 1.9% return rate for tags in this area (Tables 9 and 10).

Table 9. Summary of tag application and recoveries for NB weir.

NB Weir	# Tags Applied	# Tags Returned	# tags Returned within first 2 weeks of tagging event	% return rate (NOT adjusted to catch landings)
1998	0	0	0	0
1999	9 700	186	93	1.92
Total	**9 700**	**186**	93	**1.92**

Table 10. Summary of tag returns for NB Weir not including returns within the first two weeks of release.

Tagging Location And Date	Date Returned	Location Returned (# returned)
NB Weir Aug. & Sept. 1999	Aug. 1999	Long Island Shore (2) NB Weir (5) Location Unknown (2)
	Sept. 1999	NB Weir (17) Long Island Shore (4) Location Unknown (17)
	Oct. 1999	Schoodic Ridge (2) NB weir (1) Wolves (17) Grand Manan (10) South of Brier Island (1) Location Unknown (11)
	Nov. 1999	Wolves (2) Schoodic Ridge (1)
	Dec. 1999	Location Unknown (1)

Overwintering

An important overwintering area in Chedabucto Bay was demonstrated to exist over twenty years ago, and is managed with the assumption that the stock structure has not changed since that time (Paul, 1999). There appears to have been a change in the amount of herring at Chebucto Head, and therefore it was necessary to tag once again to identify the composition of this mixture.

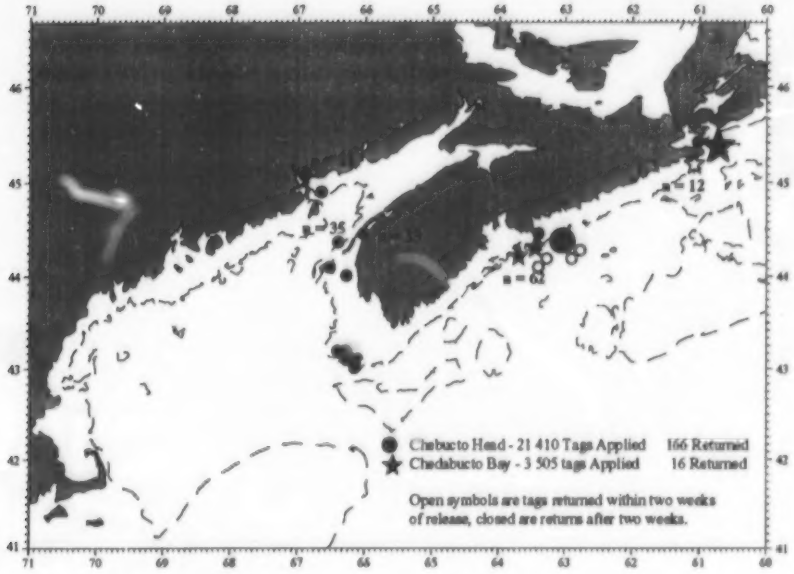
Chebucto Head - 21 410 Tags Applied 166 Returned
Chedabucto Bay - 3 505 tags Applied 16 Returned
Open symbols are tags returned within two weeks of release, closed are returns after two weeks.

Figure 4. Tag application sites and recoveries for overwintering herring.

<u>Chedabucto Bay</u> – A total of 3 505 tags were applied to the overwintering aggregation of Chedabucto Bay on Nov. 29, 1999 (Figure 4). Sixteen tags have been returned to date from this tagging effort, twelve from the tagging area and two from Chebucto Head. Tags were applied recently and therefore there is a low return rate of 0.46% for this area (Tables 11 and 12) as there has been little fishing activity during this period.

Table 11. Summary of tag application and recoveries for Chedabucto Bay.

Chedabucto Bay	# Tags Applied	# Tags Returned	# tags Returned within first 2 weeks of tagging event	% return rate (**NOT** adjusted to catch landings)
1999	3 505	16	13	0.46
2000	0	0	0	0.00
Total	**3 505**	**16**	13	**0.46**

Table 12. Summary of tag returns for Chedabucto Bay not including returns within the first two weeks of release.

Tagging Location And Date	**Date Returned**	**Location Returned (# returned)**
Chedabucto Bay Nov. 1999	Dec. 1999	Location Unknown (1)
	Jan. 2000	Chebucto Head (2)

Chebucto Head – A substantial number of tags were applied off Chebucto Head this year. 11 104 fish were tagged in two nights to add to the 10 306 tags from last year to give a grand total of 21 410 tags applied to the overwintering area at Chebucto Head (Figure 4). 105 tags have been returned from the tagging effort in 1999. These have been returned from St. Mary's Bay, Long Island Shore, Chebucto Head, Chedabucto Bay, German Bank and New Brunswick Weirs. Sixty-one tags were returned from the Chebucto Head 2000 tagging effort and all within the first two weeks of application near the application area. A 1.0% return rate has been calculated for the 1999 tagging effort (Tables 13 and 14).

Table 13. Summary of tag application and recoveries for Chebucto Head.

Chebucto Head	# Tags Applied	# Tags Returned	# tags Returned within first 2 weeks of tagging event	% return rate (NOT adjusted to catch landings)
1999	10 306	105	0	1.0
2000	11 104	61	61	0.55
Total	**21 410**	**166**	61	0.77

Table 14: Summary of tag returns for Chebucto Head not including returns within the first two weeks of release.

Tagging Location And Date	Date Returned	Location returned (# returned)
Chebucto Head Jan. 1999	May 1999	St. Mary's Bay (2)
	June 1999	St. Mary's Bay(28) Long Island Shore(10) Location Unknown (2)
	July 1999	Long Island Shore (12) Dry Ledge Buoy (1) NB Weir (4) German Bank (3) St. Mary's Bay (2) Location Unknown (6)
	Aug 1999	German Bank (2) Long Island Shore (8) NB Weir (3) Location Unknown (2)
	Sept 1999	Long Island Shore (5) NB Weir (3) St. Mary's Bay (1) South of Brier Island (1) Location Unknown (2)
	Oct 1999	Southern Wolves (1) Location Unknown (4)
	Nov 1999	Chedabucto Bay (1)
	Jan 2000	Chebucto Head (1) Location Unknown (1)

Other

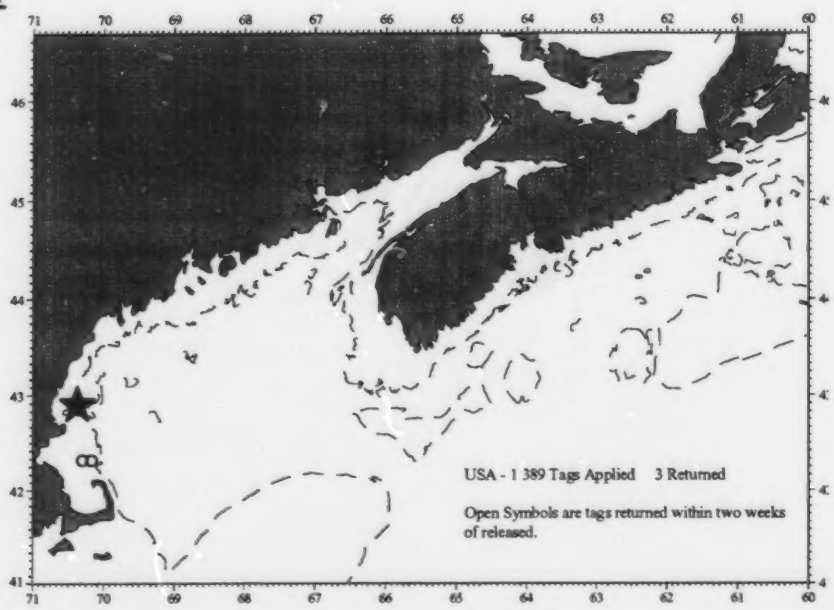

Figure 5. Experimental USA tag application site and recoveries.

USA – Herring stock structure remains an unresolved issue in both Canadian and US herring assessments and management. Further understanding is required in order to enhance complimentary Canadian and US approaches, particularly with respect to tranboundary stocks (Paul, 1999). On December 6, 1999 an experimental tagging trip in the US was undertaken and it is hoped that this will initiate a joint project. The majority of fish that were tagged were juveniles and pre spawning adults, just off of Cape Anne, Massachusetts (Figure 5). The only returns so far are three tags that were recaptured within days of the tagging event. They were found on Stellwagen Bank (Table 15).

Table 15. Summary of tag application and returns for the USA.

USA	# Tags Applied	# Tags Returned	# tags Returned within first 2 weeks of tagging event	% return rate (**NOT** adjusted to catch landings)
1998	0	0	0	0
1999	1 389	3	3	0.22
Total	**1 389**	**3**	3	0.22

Discussion

Tag returns show that herring are surviving the initial stress of being captured and tagged. There have been 203 herring recaptured within the first two weeks of tagging events, and 222 later than two weeks (the longest being 12 months).

In addition to applying tags to fish during these trips, length frequency and detail samples were taken from each location. These samples were taken back to the lab in St. Andrews and analysed for age, sex and maturity (Appendix III).

To date the information from 460 recovered herring tags has been processed and entered into a database. Individuals who returned tags received a letter telling them the release and recovery information of the tag they found and letting them know that they are eligible for the next tag draw. A tag draw for the tags returned in the first year was held this year. Beth Linton of Grand Manan, New Brunswick, and Arnold Harnish of Hubbards, Nova Scotia were the lucky winners of $1000 for the herring and mackerel draws respectively.

A preliminary experiment to examine how efficiently tags are recovered in the plants was started in 1999. Workers recovered 50% of the tags applied to herring at the plant. Due to such a low rate of recovery, and to public health and safety concerns, the experiment was concluded.

Tag recoveries have been low, but some trends can be observed in the overwintering aggregation in Chebucto Head and in the NB weir summer mixtures. Most of the recoveries from the Chebucto Head tagging have been recovered in the Nova Scotia weir fishery and on Long Island Shore. The herring that were tagged in the New Brunswick weir fishery have been recovered mostly in the coastal New Brunswick area.

Tag returns were adjusted to fish landings reported in Stephenson et al (2000) so that they were comparable among areas (Tables 16 and 17). Results were grouped by application area and year of recovery to standardized them using the landings for each group. Standardization was done by using ratio and proportion adjusted to 1000 tons resulting in number of tags recovered in each area relative to the amount of fish landed. Emphasis is placed on the long term recoveries to test hypothesis of migration patterns. Recoveries from the first two weeks of application were eliminated from both the amount tagged and the number recovered and return rates were re-calculated after this standardization (Table 16 and 17).

Table 16. Recoveries adjusted for tags returned after two weeks of release and standardized to landings for 1998 fishing season.

	Return Location	Number of Returns	% of tag returns	Landings	Tags adjusted per 1000 tons
Scots Bay 1998	Long Island Shore 1998	2	66.66	12476.00	0.16
# tagged (adjusted) = 2343	Unknown Location	1	33.33	0	
return rate (adjusted) = 0.13 %	Totals	3	100	12476.00	
Trinity Ledge 1998	Platts Bank 1999	1	33.33	3534.73	0.28
# tagged (adjusted) = 4507	Long Island Shore 1999	1	33.33	18184.00	0.05
return rate (adjusted) = 0.07 %	Unknown Location	1	33.33	0	
	Totals	3	100		
German Bank 1998	German Bank 1998	6	66.66	20698.00	0.29
# tagged (adjusted) = 9019	NS Weir 1999	1	11.11	5431.1	0.18
return rate (adjusted) = 0.10%	Unknown Location	2	22.22	0	
	Totals	9	100	26129.1	
Chebucto Head 1999	NS Weir 1999	33	31.73	5461.1	6.04
# tagged (adjusted) = 10202	Long Island Shore 1999	36	34.61	18184.00	1.98
return rate (adjusted) = 1.0 %	Dry Ledge 1999	1	0.96	10111.00	0.10
	NB Weir 1999	10	9.61	18234.2	0.55
	German Bank 1999	5	4.80	24876.23	0.20
	Chedabucto Bay 1999	1	0.96	1235.22	0.81
	Chebucto Head 2000	1	0.96	1019	0.98
	NB Coastal 1999	1	0.96	1891	0.53
	Unknown Location	16	15.38	0	
	Totals	104	100	81011.75	

Table 17. Recoveries adjusted for tags returned after two weeks of release and standardized to fish landings for the 1999 fishing season.

	Return Location	Number of Returns	% of tag returns	Landings	Tags adjusted per 1000 tons
Scots Bay 1999					
# tagged (adjusted) = 2961	Long Island Shore 1999	3	50	18184.00	0.16
return rate (adjusted) = 0.2 %	NB Weir 1999	2	33.33	18234.2	0.11
	Unknown Location	1	16.66	0	
	Totals	6	100	36418.20	
NB Weir 1999					
# tagged (adjusted) = 9607	Long Island Shore 1999	7	7.53	18184.00	0.38
return rate (adjusted) = 0.97 %	NB Weir 1999	23	24.73	18234.2	1.26
	Schoodic Ridge 1999	3	3.23	6939.53	0.43
	Grand Manan 1999	10	10.75	7901.00	1.27
	NB Coastal 1999	19	20.43	1891	10.05
	Unknown Location	31	33.33	0	
	Totals	93	100		
Chedabucto Bay 1999					
# tagged (adjusted) = 3502	Chebucto Head 2000	2	66.66	1019	1.96
return rate (adjusted) = 0.08%	Unknown Location	1	33.33	0	
	Totals	3	100	1019	

Recommendations for future research

- In order to maximize the number of tag returns, it is recommended that there be a renewal of the advertising campaign. This campaign would involve plant visitations and presentations of the program, putting up more posters, and conducting another substantial mail out to the industry and other related organizations. Plant tours should focus on areas around northern and eastern shores of Nova Scotia, including Cape Breton, especially if herring are tagged in the Bras d'Or Lakes. Prince Edward Island and Newfoundland and the eastern coast of the United States should be targeted for a significant mail out.

- The project has established a target of 10 000 tags per area, in order to get sufficient recoveries. Since designated tagging trips may often be cancelled due to weather, as was the case on Trinity Ledge and German Bank in 1999, it is necessary to supplement these trips with tagging on fishing nights. It is therefore recommended that there should be tagging on designated tagging trips and on fishing nights to achieve the target.

- In the past five years there has been considerable concern expressed over the status of the Bras d'Or Lakes spawning group. In 2000, it is proposed that a tagging program be instigated in the Bras d'Or Lakes and for the fall herring fishery off Glace Bay. The last tagging initiative in the Bras d'Or Lakes occurred over two decades ago and involved less than 500 fish. No tagging has been conducted on the Glace Bay gillnet fishery. For 2000 it is recommended that herring be tagged on spawning grounds (Bras d'Or Lakes and 4T in spring, off Glace Bay in the fall) and in the 4Vn winter fishery to determine the extent of movement and migration patterns, and fidelity to spawning grounds (Paul, 1999).

- There is limited information about herring on the offshore Scotian Shelf (The Patch). Tagging would provide useful data regarding migration patterns. It is therefore recommended that herring from this area be tagged in the 2000 season.

- Once fish are tagged and released, the most important component of a tagging study is the recovery of tags. An estimation of tagging mortality and tag loss would give an indication of expected recovery rates, and would be an important part of analyzing recovery data (Paul, 1999). It is recommended that such a study be completed in 2000.

- It is recommended that turnover on spawning grounds be re-examined in the coming year. An examination of the short-term recoveries would shed some more light on how long herring remain on their spawning grounds after spawning. This is very important to the current assessment methods (Melvin and Power, 1999)(Paul, 1999).

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Appendix I: Tag Application Summary

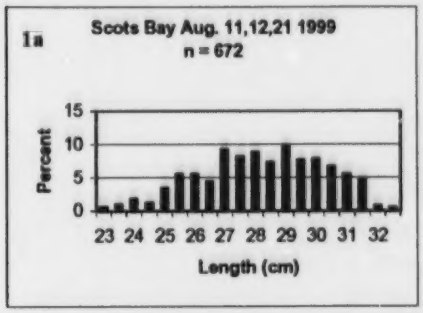
Area	Date	# Of Tags	*Total 1998*	*Total 1999*	*Grand Total*
Scots Bay	23-Aug-98	1886			
	25-Aug-98	480			
	11-Aug-99	1 034			
	12-Aug-99	457			
	21-Aug-99	1 476	**2 346**	**2 967**	**5 313**
NB Weir	16-Aug-99	1 262			
	17-Aug-99	814			
	18-Aug-99	1608			
	23-Aug-99	1129			
	24-Aug-99	1368			
	30-Aug-99	936			
	31-Aug-99	1049			
	08-Sep-99	1534		**9 700**	**9 700**
Trinity Ledge	27-Aug-98	536			
	11-Sept-98	1436			
	12-Sep-98	1378			
	25-Sep-98	1160	**4510**		**4 510**
German Bank	20-Aug-98	240			
	31-Aug-98	118			
	01-Sep-98	1349			
	02-Sep-98	763			
	03-Sep-98	394			
	08-Sep-98	582			
	09-Sep-98	2 162			
	13-sep-98	741			
	14-Sep-98	480			
	20-sep-98	620			
	21-Sep-98	1048			
	22-sep-98	571			
	21-Sep-99	298			
	22-Sep-99	516	**9068**	**814**	**9 882**
Eastern Passage	01-Oct-99	1896		**1896**	**1 896**
Chedabucto Bay	29-Nov-99	3505		**3505**	**3 505**
USA	07-Dec-99	1389		**1389**	**1 389**
Chebucto Head	21-Jan-99	1225			
	22-Jan-99	4888			
	26-Jan-99	4193			
	8-Jan-00	3946			
	9-Jan-00	7158	**10 306**	**11104**	**21 410**
Totals			**26 230**	**31 375**	
					57 603

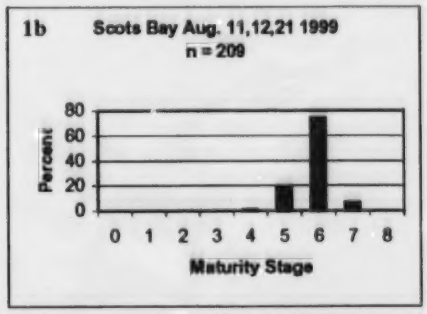
Appendix II: Total Herring Tag Returns by Tagging Area and Return Location

Application Location	Number Returned	Location Returned	
Chebucto Head			
(21 410)	62	Chebucto Head	
	1	Chedabucto Bay	
	1	Dry Ledge Buoy	
	5	German Bank	
	26	Long Island Shore	
	9	Moore's Ledge	
	10	NB Weir	
	23	NS Weir	
	10	Saint Mary's Bay	
	1	South of Brier Island	
	1	Southern Wolves	
	17	unknown	T = 166
Chedabucto Bay			
(3 505)	2	Chebucto Head	
	12	Chedabucto Bay	
	2	Unknown	T = 16
German Bank			
(9 882)	42	German Bank	
	1	Saint Mary's Bay	
	1	Seal Island	
	6	unknown	T = 50
NB Weir			
(9 700)	10	Long Island Shore	
	77	NB Weir	
	8	Off Grand Manan	
	3	Schoodic Ridge (off of ME)	
	1	Seal Cove, Grand Manan	
	1	South of Brier Island	
	17	Southern Wolves	
	58	unknown	

Application Location	Number Returned	Location Returned	
	9	White Head, NB	
	2	Wolves	T = 186
Scots Bay			
(5 313)	6	Long Island Shore	
	2	NB Weir	
	21	Scots Bay	
	3	unknown	T = 32
Trinity Ledge			
(4 510)	3	German Bank	
	1	Long Island Shore	
	1	Platts Bank	
	2	unknown	T = 7
USA			
(1 389)	2	Lower End Stellwagen Bank	
	1	unknown	T = 3

Appendix III: Herring Sample Information at Time of Tagging.





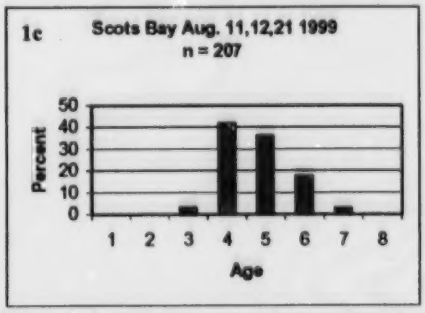
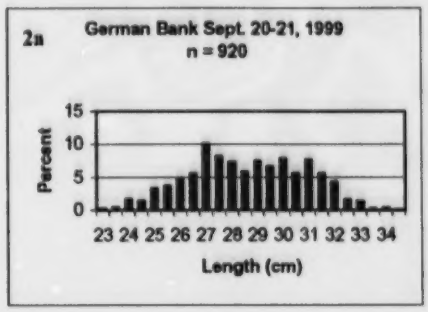
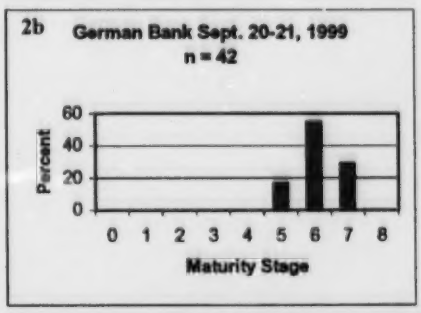


Figure 1: Length frequency (a), maturity (b) and age (c) of fish sampled during tagging on Scots Bay, Aug 11, 12 and 21, 1999.





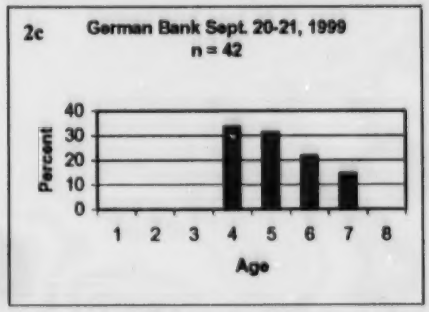
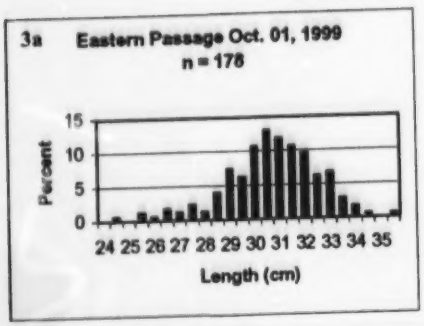
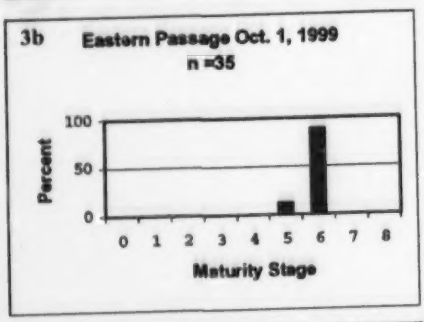


Figure 2: Length frequency (a), maturity (b) and age (c) of fish from German Bank, Sept. 20 and 21, 1999. There was no detail sample taken on Sept. 21 so information came from other samples taken from German Bank that night.





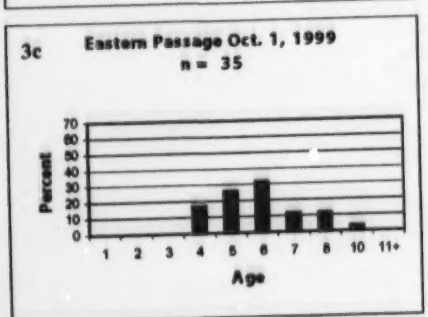
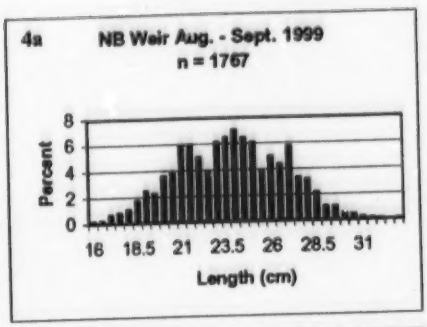
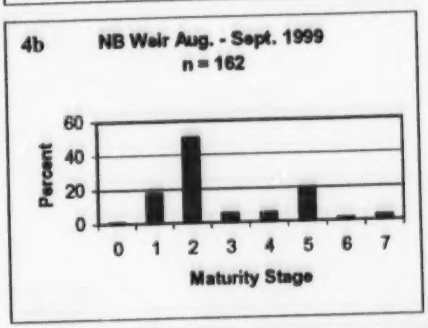


Figure 3: Length frequency (a), maturity (b) and age (c) of fish sampled during tagging on Eastern Passage Oct. 1, 1999.





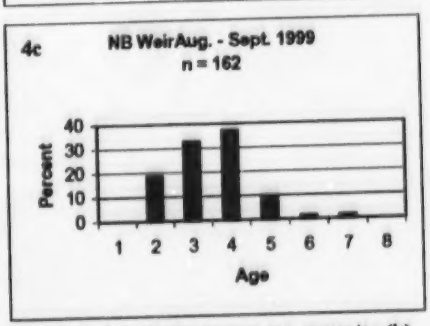
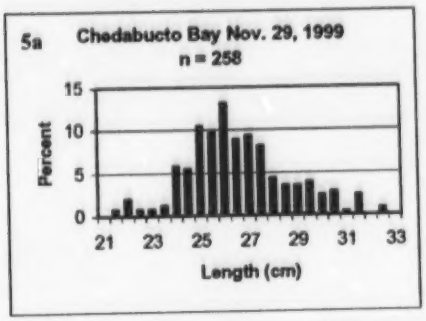
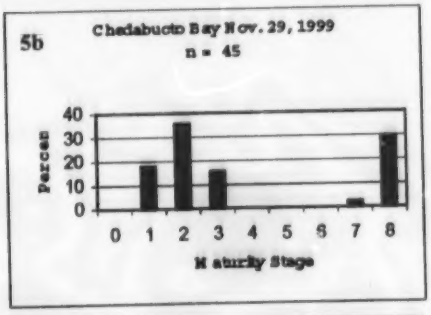


Figure 4: Length frequency (a), maturity (b) and age (c) of fish sampled during tagging on NB Weirs in Aug. and Sept. 1999.





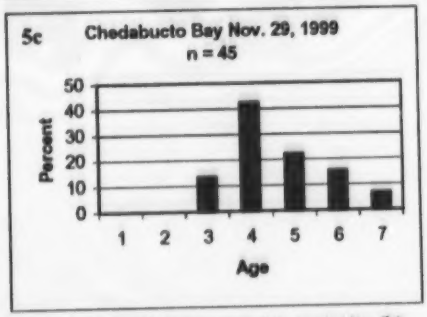
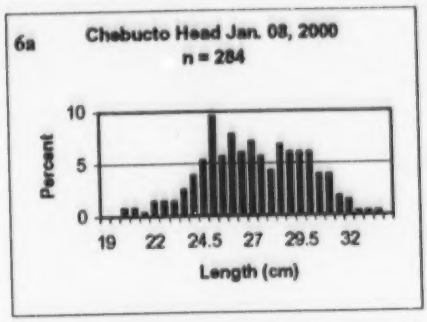
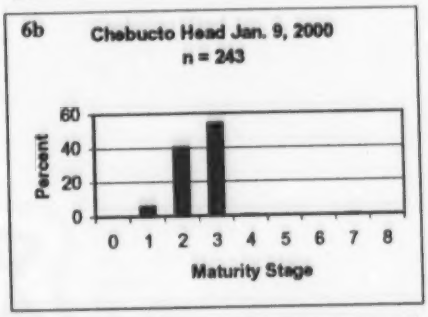


Figure 5: Length frequency (a), maturity (b) and age (c) of fish sampled during tagging on Chedabucto Bay Nov. 29, 1999.





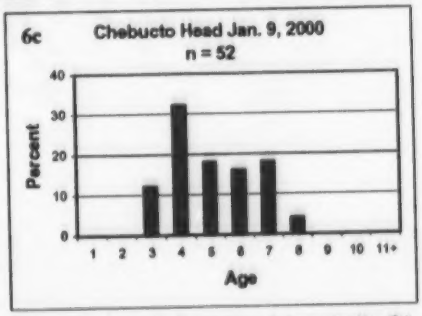
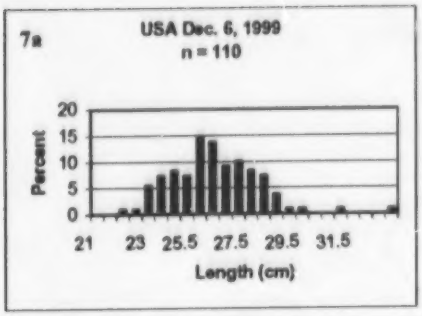
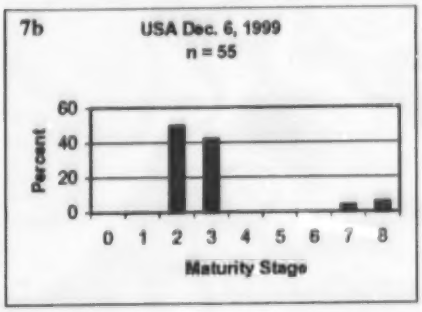


Figure 6: Length frequency (a), maturity (b) and age (c) of fish sampled during tagging on Chebucto Head Jan. 9, 2000.





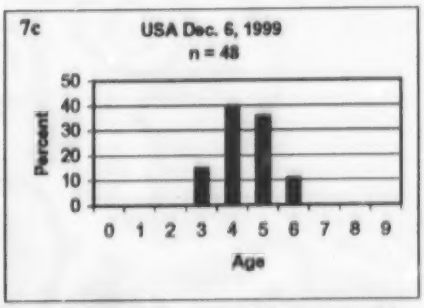


Figure 7: Length frequency (a), maturity (b) and age (c) of fish sampled during tagging in the USA on Dec. 6, 1999

Appendix IV: Mackerel Tagging Program Information

Due to lack of funding the mackerel tagging program was significantly reduced in 1999. The PRC conducted one trip to St. Margaret's Bay this year. The trip took place over three days from September 14 to 16. 3 019 tags were applied to adult and juvenile mackerel on this trip. This added to the 10 071 tags applied in St. Margaret's 1998 bringing the total for St. Margaret's Bay to 13 090. There were no tagging trips to Aspy Bay this year, therefore the only fish tagged in this area are the 788 that were tagged in the summer of 1998. A total of 13 878 tags have been applied to mackerel since 1998. To date 82 tags have been returned (Table 18).

Table 18. Summary of mackerel tagging trips and recoveries.

Area	Date	Length (cm)	# Fish Tagged	Recoveries
Aspy Bay	June 19-25, 1998	27.0 – 40.5	788	9
St. Margaret's Bay	July 8 – 23, 1998	21.0 – 34.5	10 071	73
St. Margaret's Bay	Sept.14 – 16, 1999	16.0 – 33.5	3 019	0
			13 878	82

St. Margaret's Bay – Tagging was done off Fox Point on a designated trip. There were two distinct sizes of mackerel (Appendix V). Fish were tagged from both size groups, but there was a greater focus on the larger fish. There have been no recoveries from tagging done this year, probably because it was done so late in the year.

There have been a total of 73 recoveries from the tagging efforts in 1998. The last tag was returned on June 8, 1999, 330 days after tagging (Tables 19 and 20).

Table 19. Summary of tag application and recoveries for St. Margaret's Bay.

St. Margaret's Bay	# Tags Applied	# tags Returned	# tags returned within first 2 weeks of tagging event	% return rate (NOT adjusted to catch landings)
1998	10 071	73	18	0.72
1999	3 019	0	0	0.00
Total	**13 090**	**73**	18	**0.56**

Table 20. Summary of tag returns for St. Margaret's Bay.

Tagging Location and Date	Date Returned	Location Returned (# Returned)
St. Margaret's Bay July 8 – 23, 1998	July 1998	Hackett's Cove, NS (6) Boutilier's Point, NS (3) St. Margaret's Bay, NS (3) French Village Harbour, NS (1) Ecum Secum, NS (1) Gabarus Bay, NS (1) Sambro Harbour, NS (1)
	Aug. 1998	Peggy's Cove, NS (7) Croucher Island, NS (1) New Waterford, NS (1) Hubbards Cove, NS (2) Blind Bay, NS (1) Cranberry Island, NS (1) Gabarus, NS (1) French Village Harbour, NS (1) Chedabucto Bay, NS (1) Jeddore Harbour, NS (1) Sambro Harbour, NS (1) Fox Island, NS (1) St. Peter's Bay, NS (1) Quensland, NS (4)
	Sept. 1998	Cranberry Island, NS (4) Ecum Secum, NS (2) Boutilier's Point, NS (1) Port Bickerton, NS (1) Liverpool Harbour, NS (1) Queensport Harbour, NS (1) Mill Cove, NS (2) Sambro Harbour, NS (1) Three Fathom Harbour, NS (1) Marie Joseph Harbour, NS (1)
	Oct. 1998	Mill Cove, NS (5) Glace Bay, NS (1) Queensland, NS (2)
	Dec. 1998	Goucester, Massachusetts (1)
	Jun. 1999	White Head Island, NS (1)

Aspy Bay – Tagging was not conducted in Aspy Bay this year. Results from the 1998 effort are shown in tables 21 ands 22.

Table 21. Summary of tag application and returns for Aspy Bay.

Aspy Bay	# Tags Applied	# tags Returned	# tags returned within first 2 weeks of tagging event	% return rate (NOT adjusted to catch landings)
1998	788	9	6	1.14
1999	0	0	0	0.00
Total	**788**	**9**	6	**1.14**

Table 22. Summary of tag returns for Aspy Bay.

Tagging Location and Date	Date Returned	Location Returned (# Returned)
Aspy Bay June 19 – 25, 1998	June 1998	Aspy Bay (6)
	Aug. 1998	Iles-de-la-Madeleine (1)
	Oct. 1998	Iles-de-la-Madeleine (2)

Table 23. Total Mackerel Tag Returns by Tagging Area and Return Location

Application Location	Number Returned	Location Returned	
Aspy Bay			
(788)	6	Aspy Bay	
	3	Iles-de-la-Madeleine	T = 9
St. Margaret's Bay			
(13 090)	1	Blind Bay, Hfx Co., NS	
	4	Boutilier's Point, SMB	
	1	Chedabucto Bay, NS	
	5	Cranberry Island, NS (near Canso)	
	1	Croucher Island, SMB	
	3	Ecum Secum, NS	
	1	Fox Island, NS	
	2	French Village Harbour, SMB	
	2	Gabarus Bay, NS	
	1	Glace Bay, NS	
	1	Goucester, Massachusetts	
	6	Hackett's Cove, SMB	
	2	Hubbards Cove, SMB	
	1	Lennox Passage, NS	
	1	Liverpool Harbour, NS	
	1	Marie Joseph Harbour, NS	
	7	Millcove, SMB, NS	
	1	mouth Jeddore Hbr., NS	
	1	New Waterford (1/2 mi from shore)	
	7	Peggy's Cove, SMB, NS	
	1	Port Bickerton, NS	
	6	Queensland, SMB, NS	
	1	Queensport Harbour, NS	
	4	Sambro Harbour, NS	
	1	Sheet Harbour, NS	
	6	St. Margarets Bay, NS	
	1	St. Peters Bay, NS	
	1	Three Fathom Harbour, NS	
	2	unknown	
	1	White Head Is. Gys. Co., NS	T = 73

Mackerel Sample Information at Time of Tagging.

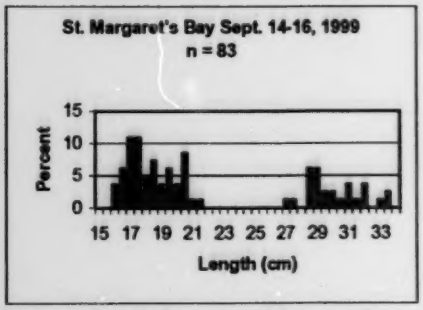


Figure 3: Length frequency of fish sample collected during tagging in St. Margaret's Bay, Sept. 14-16, 1999.